

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
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4000 BLADDER ASSEMBLY FLOCKED, ITEM 106, (1) LEFT (1) RIGHT	2/1R	Delamination of bladder flocking.	END ITEM: Flocking separated from bladder.	A. Design - 4000/Phase VI: White cotton fibers, 1/32 to 3/64 inch long, enhance donning and comfort of the glove bladder. Flock is bonded to the bladder interior using a moisture cure polyether polyurethane adhesive. Flock distribution is uniform and the orientation is random. Localized flock separation and adhesive erosion occur as a function of normal wear over time. Adhesive/flock delamination due to defective adhesive is precluded by adherence to rigidly controlled procurement and in-process engineering standards.
0106-88971-11/12 0106-811648-01/02 (2)		Abrasion wear, or defective material/ adhesive.	GFE INTERFACE: Flock accumulation downstream in vent plenum partially blocking vent flow.	B. Test - Acceptance: 4000/Phase VI: As required by the table of operations governing the stages of fabrication and assembly of the glove assemblies, the following test is conducted: Physical properties (modulus, ultimate tensile, ultimate elongation and tear strength) for each bladder, pre- and post-flocked, are verified by test of samples fabricated in parallel with the item.
OR PHASE VI BLADDER ASSEMBLY ITEM 106 (1) LEFT (1) RIGHT			MISSION: Terminate EVA.	
0106-812537-01/02 (2)			CREW/VEHICLE: None for single failure. Loss of crewman with additional failure of vent flow sensor.	PDA: The following tests are conducted at the Glove Assembly level in accordance with ILC Document 0111-70028 for the 4000 Series gloves and 0111-710112 for the Phase VI gloves:  Manned break-in cycling (1000 cycles) to exercise bladder and verify no flock delamination.  Certification: 4000: The glove assembly was successfully tested (manned) during SSA certification testing to duplicate operational life (Ref. ILC Document 0111-79241).
			TIME TO EFFECT /ACTIONS: Minutes.	The following usage, reflecting requirements of significance to the glove bladder assemblies, was documented during certification:
			TIME AVAILABLE: Days.	Requirements (4000 Bladder)                      S/AD                      Actual -----
			TIME REQUIRED: Hours.	Glove Joint Cycles Flex/Ext (Fingers)                      42,412                      56,726 Wrist Joint Cycles
			REDUNDANCY	ADD/ABD                      21,206                      29,484
			SCREENS:	Flex/Ext.                      21,206                      29,484
			A-PASS	Rotation                      21,206                      29,484
			B-PASS	Pressurized Hours                      461                      615
			C-PASS	Pressurized Cycles                      432                      576
				Don/Doff                      144                      192

The glove assembly was successfully subjected to an ultimate pressure of 13.2 psig during SSA certification (Ref. ILC Document 0111-79241). This is 1.5 times the BTA maximum operating pressure of 8.8 psig. Recertification to 5.5 psi was by test and analysis (Ref. ILC EM 84-1108).

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The following usage, reflecting requirements of significance to the Bladder Assembly (0106-811648), was documented during certification:

Requirement	S/AD	Actuals
Glove Joint Cycles		
Flex/Ext	42,412	43,500
Wrist Joint Cycles		
Add/Abd	21,206	22,620
Flex/Ext	21,206	22,620
Rotations	21,206	22,620
Pressurized Hours	461	461
Pressurized Cycles	432	437
Donn/Doff	144	192

The Glove Bladder Assembly (0106-811648) was successfully subjected to an ultimate pressure of 13.2 psig during testing (Ref Document 0111-711671). This is 1.5 times the maximum BTA operating pressure of 8.8 psig.

Phase VI:

The glove restraint assembly was successfully tested (manned) during certification testing to duplicate operational usage (Ref. Certification Test Report for the Phase VI Glove, ILC Doc. 0111-712701). The following usage, reflecting requirements of significance to the glove restraint assembly, was documented during certification testing. The S/AD applies 229 hours in certification while the actual indicates 176 hours toward the Phase VI glove restraint in the Hamilton Sundstrand Limited Life Items list (EMU1-19-001).

Requirements	S/AD	Actual
Glove Joint Cycles		
Flex/Ext (fingers)	45142	34834
Wrist Joint Cycles		
Add/Abd	17104	13176
Flex/Ext	12646	9496
Rotations	20112	15421

The glove assembly was successfully subjected to an ultimate pressure of 13.2 psig during Certification Testing (Ref. ILC doc 0111-712701). This is 1.5 times the maximum BTA operating pressure based on 8.8 psig.

C. Inspection -  
 4000/Phase VI:

Material manufactured to ILC requirements at an approved supplier are documented from procurement through shipping by the supplier. ILC incoming receiving inspection verifies that the materials received are as identified in the procurement document, that no damage has occurred during shipment and that appropriate data have been received which provide traceability information.

The following MIP's are performed during the glove assembly manufacturing process to assure that the failure causes are precluded from the fabricated item:

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1. Verify correct preparation of adhesive solution.
2. Verify adhesive solution is within characteristics specifications (% solids, viscosity).
3. Inspection for flock coverage.

During PDA, the following inspection points are performed at the Glove Assembly level in accordance with ILC Document 0111-70028 (4000 glove) or 0111-710112 (Phase VI glove):

1. Visual inspection for material degradation.
2. Visual inspection for structural damage after proof pressure tests.
3. Visual inspection for structural damage after cycle testing.

D. Failure History -

4000/Phase VI:

B-EMU-106-A049 (7/23/99) - Excessively worn areas on palm side of bladder on both gloves. Most likely cause was abrasion from motion of softgoods against glove bladder during normal use. None. Phase VI gloves also experienced abrasion during test and a teflon liner in the wrist has been incorporated.

E. Ground Turnaround -

4000/Phase VI:

During ground turnaround in accordance with FEMU-R-001, the glove assemblies are subjected to structural, leakage and visual inspection. Additionally, a glove fit check (with the crewperson) verifies glove assemblies are easily donned.

F. Operational Use -

4000/Phase VI:

Crew Response -

Pre/post-EVA : Troubleshoot problem, if no success, consider using spare gloves if available. Otherwise terminate EVA operations.

EVA : When CWS data confirms loss of vent flow, assess suit for CO2 level and fogging. If symptoms noted, terminate EVA with purge valve open. If no symptoms noted, continue EVA, periodically evaluate for CO2 symptoms or fogging. Training - Standard EMU training covers this failure mode.

Operational Considerations - Flight rule A15.1.2-2 of "Space Shuttle Operational Flight Rules", NSTS-12820 defines go/no go criteria related to EMU ventilation flow and CO2 control. Generic EVA Checklist, JSC-48023, procedures Section 3 (EMU Checkout) and 4 (EVA prep) verify hardware integrity and systems operational status prior to EVA. Real Time Data System allows ground monitoring of EMU systems.

EXTRAVEHICULAR MOBILITY UNIT  
SYSTEMS SAFETY REVIEW PANEL REVIEW  
FOR THE  
I-106 GLOVE ASSEMBLY  
CRITICAL ITEM LIST (CIL)

EMU CONTRACT NO. NAS 9-97150

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